



Topics



- Mission Summary
- Spacecraft Subsystems Summary
- Recent Activities
- Planned Activities
- Propellant Usage & Lifetime Estimates
- Overall Summary
- Additional Slides:
 - Spacecraft Maneuvers & Ground Track History
 - Conjunction Assessment
 - Data Capture & Ops Error Statistics
 - Extended Mission Plans

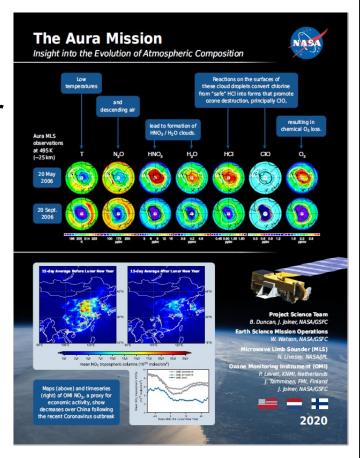


EOS Aura Mission Summary



(Updates since December 2019 MOWG @ Gilbert, AZ)

- 07/15/04: Launch
 - 6-Year Design Life
- 09/30/10: End of Prime Mission Review
- 09/18/15: 2015 Mission Extension Senior Review Proposal Panel Report
- 03/03/17: Senior Review Proposal #5
- 02/04/20: ESMO Annual Review #13
- 03/03/20: Senior Review Proposal #6
 - Reliability Estimates through 2025
 - Consumables through 2024
 - Updated Aura Phase F Plan
- 07/10/20: Senior Review Earth Science Subcommittee Presentation
 - Awaiting results and NASA HQ Guidance
- 07/15/20: Aura 16-Year Anniversary





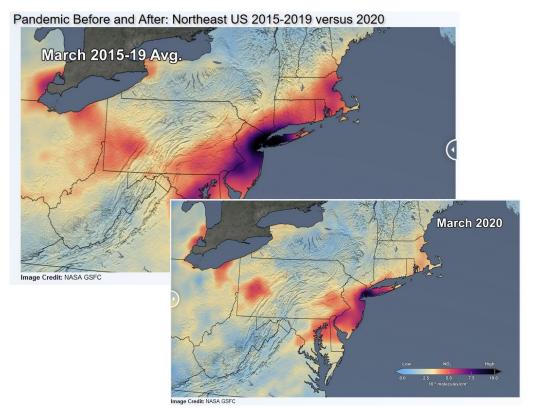
Aura's 16th Anniversary!



Launch Date: July 15, 2004



Aura's long-term data record continues to produce tremendous scientific value



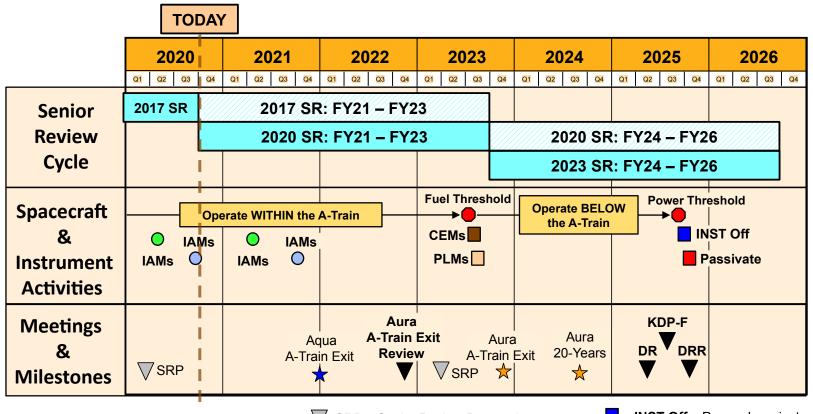
https://airquality.gsfc.nasa.gov/slider/northeast-2020

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Aura Extended Mission Timeline





- Senior Review Funding (Approved)
- Senior Review Funding (Preliminary Guideline)
- IAMs Spring Inclination Adjust Maneuvers
- O IAMs Fall Inclination Adjust Maneuvers
- CEMs Constellation Exit Maneuvers
- PLMs Perigee Lowering Maneuvers

- SRP Senior Review Proposal
- A-Train Exit Review (~late 2022)
- **DR** Decommissioning Review
- ▼ KDP-F HQ Key Decision Point to proceed with Phase F
- **DRR** Disposal Readiness Review ESC MOWG September 2020

- INST Off Power down instruments
- Passivate Spacecraft passivation

NOTE: Activity & Milestone dates dependent on spacecraft performance (i.e., fuel and power limitations)

4



Aura Spacecraft Subsystems



(No changes since December 2019 MOWG @ Gilbert, AZ)

- Command & Data Handling (CDH) Nominal
 - Formatter Multiplexer Unit (FMU) / Solid State Recorder (SSR) Anomaly
 - » Initial symptoms occurred December 4-18, 2007
 - » Newest symptoms started in January 2017 and remain active (impacting S-Band HK data capture)
- Communications (COMM) Nominal
 - Transmitter-B Reflected Power Anomaly (10/17/17, 01/05/18)
- Electrical Power System (EPS) Nominal
 - Array Regulator Electronics (ARE) Anomalies:
 - » Solar Panel Connector Anomaly ARE-3C (01/12/05) loss of 11 strings
 - » MMOD Strike ARE-5A (3/12/10) loss of 6 strings
 - ARE Degradation (due to aging):
 - » ARE-1A (3/12/10, 11/5/11), ARE-1C (7/14/17, 12/22/17), ARE-2A (8/24/19), ARE-2C (8/18/17), ARE-4A (9/23/14, 12/8/14), ARE-4C (6/6/19), ARE-5A (4/25/13), ARE-5C (9/27/12, 2/4/13), and ARE-6A (9/14/13)
 - Estimated that Aura has lost 33 strings of solar cells out of a total of 132 strings (~75.0% remain)
- Flight Software (FSW) Nominal
- Guidance, Navigation & Control (GN&C) Nominal
- Propulsion (PROP) Nominal
- Thermal Control System (TCS) Nominal

All subsystems configured to primary hardware

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(December 2019 - August 2020)

- 0 Spacecraft Bus Anomalies
- 0 Instrument Anomalies
 - 0 MLS Anomalies
 - » Last Anomaly: Receiver 2 Anomaly (07/18/19, recovered on 07/24/19)
 - OMI Anomalies
- 13 Spacecraft Maneuvers
 - 6 Drag Make-up Maneuvers (DMUMs #131 136)
 - » Routine Maintenance: 02/12/20, 04/29/20, 06/03/20, 06/25/20, 07/29/20
 - » Risk Mitigation Maneuver (RMM): 01/03/20
 - 7 Inclination Adjust Maneuver (IAMs #64 #70)
 - » Spring 2020 IAMs: 03/04/20, 03/11/20, 03/25/20, 04/01/20
 - » Fall 2020 IAMs: 08/19/20, 09/09/20, 09/16/20
- 1 Instrument Maneuver
 - » MLS Yaw #15 (Moon Scan) 03/11/20
- 8 High Interest Events (HIEs) (Tiers 1-4) (As of 08/31/20 more details in back-up)
 - 4 Tier 3 Events (T3) maneuver options planned and screened
 - 1 Tier 4 Events (T4) maneuver executed
 - » 01/03/2020: Aura vs. 13498 at 22:50:31 GMT moved up scheduled DMU to earlier date





(December 2019 - August 2020)

COVID-19 Response & Impacts

- Following NASA / GSFC response framework currently in Stage 3 (mandatory telework)
- Operations teams have been successful in minimizing on-site presence to only essential personnel
- Meeting mission requirements and performing critical activities with a majority of the staff working remote (i.e., maneuver monitoring & anomaly response)

Aura GNC Earth Sensor Assembly (ESA) Patch

- FOT had been monitoring an on-going roll & pitch bias drift that saw an increased frequency of limit excursions
- Calibration parameters were updated in 2009 to mitigate attitude estimation errors but since that time the errors have slowly continued to drift
- NGSS recommended some new calibration parameters, along with a redesigned pitch filter in June 2020
- FOT generated the new products and verified the contents on the simulator
- FOT uplinked Part 1 of the patch (new calibration parameters) on 08/13/20
- Plans are to uplink Part 2 of the patch (new pitch filter) in October 2020





(December 2019 - August 2020)

Aqua / Aura Maneuver Working Group (MWG)

- Aqua RWA IAM Development
 - » Successfully completed the 2020 Spring & Fall IAM Series using RWAs for the slew portion
 - » FDS estimates fuel savings of ~1.4 kg and ~25% increase in ΔINC efficiency (degrees / kg)

Thruster Performance Degradation Investigation

- » Results from the Spring 2020 IAMs continued to show Aqua thruster degradation (decreasing Thrust Scale Factor (TSF))
- » Worked with NGSS to assess performance data not a spacecraft safety concern
- » Successfully performed individual thruster test burns on Aqua 07/01/20
- » Continuing to monitor thruster performance on Aura no plans for thruster test at this point

Aqua / Aura IAM Planning

- » FOT & FDS debriefed the performance of the Spring series on 04/22/20
 - Aqua: 2.9% COLD, Aura: 1.5% COLD
- » Following the performance of the Spring 2020 IAMs changes were made to the Fall 2020 IAM plan to increase from 2 to 3 IAMs

Retrograde Maneuver (RM) Capability Development – CEMs / PLMs

- » FOT & FDS presented some preliminary analysis on CEM timing and limitations
- » Discussions with Aqua / Aura instrument teams were held to work through details





(December 2019 - August 2020)

- Ozone Monitoring Instrument (OMI) Operations Transition
 - Kick-off meetings with the FOT, IOT, and Science Team held in September 2019
 - Handed over load approvals to the FOT in December 2019
 - Stopped 24/7 support from KNMI as of January 1st, 2020
 - Status meetings continue to be held monthly with the FOT & IOT
 - Updated OMI baseline orbit-type activities (N1, D1, W2, M2) in May 2020
 - Forced to cancel site-visit from KNMI personnel (May 11th 13th)
 - Parallel activity scheduling from June-Sept and handover to occur in Oct 2020
- TES Laser End of Life (EOL) Testing [since Decommissioning on 01/31/18]
 - Phase 2 testing will alternate leaving Laser A or B ON for extended durations and characterize performance every 6 months
 - Previous Phase 2 Testing:
 - » Round 1 (November 2018), Round 2 (April 2019), & Round 3 (October 2019)
 - Round 4 Testing Postponed due to COVID-19 operations limitations
 - » Originally planned for April 2020
 - » Future discussions with the FOT / IOT to see if there is potential to support testing remotely



Planned Activities



- Fall 2020: Respond to 2020 Senior Review Guidance
- Fall 2020: FDS Lifetime Analysis Updates
 - Updates to incorporate Fall IAM performance and new DAS solar flux predicts
- February 2021: ESMO Annual Review #14
- Spring 2021: Earth Science Constellation (ESC) MOWG
 - Update propellant budget, decommissioning analysis, reliability predictions, etc.
- Spring 2021: Bi-annual Inclination Adjust Maneuvers (4)
 - 2/24/20 (#71), 3/3/20 (#72), 3/10/20 (#73), 3/17/20 (#74), 3/24/20 (Backup)
- Mid-to-Long-Term Plans:
 - Maneuver Working Group (MWG)
 - » Retrograde Maneuver (RM) capability development (CEM / PLM schemes)
 - Decommissioning Working Group (DWG)
 - » End of Mission activity planning and spacecraft passivation sequence development
 - EOS Automation (EA) automation of routine operations
 - » Continue FOT automation procedure development into 2021
 - Mission Operations Conjunction Assessment (MOCA)
 - » Continue to improve process CRMS Release 9.0 expected in early 2021



Spring 2021 Inclination Adjust Plan



Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
21 February	22	23	24 Aura IAM #71	25 Aqua IAM #74	26	27
28	1 March	2	3 Aura IAM #72	4 Aqua IAM #75	5	6
7	8	9	10 Aura IAM #73	11 Aqua IAM #76	12	13
14	15	16	17 Aura IAM #74	18 Aqua IAM #70	19	20
21	22	23	24 Aura Backup	25 Aqua Backup	26	27
28	29	30	31	1 April	2	3



Collision Risk Management System (CRMS) Process Improvements



- ESMO has developed ground system capabilities to autonomously identify and develop maneuver options to assist in Risk Mitigation Maneuver (RMM) / Debris Avoidance Maneuver (DAM) planning
- Developed in response to an increased number of predicted close approaches with orbital debris and operational satellites
 - More High Interest Events (HIEs) had led to more effort to plan mitigation maneuvers
 - Concern is that updates to the US Air Force Space Fence will significantly increase the size of the Space Catalog
- Key CRMS capabilities include:
 - User defined collision risk thresholds
 - Maneuver optimization to address multiple conjunctions with secondary object conjunctions
- ESMO developed MOCA CONOPS in support of CARA Devolution initiative
 - Completed Parallel Ops test phase in Fall 2019 (09/26/19)
- EOC is currently operating with CRMS Release 8 (ORR 02/25/20)



Aura Propellant Usage



- 2006: Initial Aura lifetime fuel analysis
- 2008: Detailed Aqua & Aura lifetime analysis
 - Presented to MOWG and at Aura End of Prime Mission Review in September 2010
- 2012 (September): Initial Aura Decommissioning Plan
 - Included updated Lifetime Estimates
- 2013 (August): Updated Decommissioning Plan
 - Included updated Constellation Exit Plan
- 2014 (September): Updated Decommissioning Plan
- 2015 (September): Decommission Plan Update Postponed
 - Postponed to evaluate long-term plan and decommissioning maneuvers
- 2016 (January): Updated Decommission Plan (v1.2)
 - Included hypothetical MLT drift analysis with LS-8
- 2017 (October): Updated Decommission Plan (v1.0)
- 2018 (July): Updated Decommission Plan (v1.0)
 - Summer IAM required update to document and IAM Plans
 - Included Appendix B with alternate plan to drift after 2019 IAMs
- 2018 (November): Updated Decommission Plan (v2.0)
 - Updated definitive fuel usage & predicted solar flux levels
 - Updated propellant estimates for IAMs w/ RWAs & DMUs
- 2019 (July): Updated Decommission Plan (v1.0)
 - Update definitive fuel usage & predicted solar flux levels
- 2020 (October): Expect updated report following analysis of Fall
 2020 IAM series
- Final will be produced 60 days before start of decommissioning





Remaining Fuel Estimate



- Long-term orbit simulations were run for Aura through Feb 2023
 - Used mean nominal Schatten solar flux predictions (May 2020)
 - Estimated the frequency of drag make-up maneuvers to maintain Aura's WRS-2 ground track requirements
 - Estimated the required number of annual inclination maneuvers for Aura to maintain it's mean local time (MLT) requirement (9 IAMs remaining)
 - Did not include potential debris avoidance maneuvers
 - Utilized FreeFlyer 6.10.0 which incorporated the solid earth tide model allowing greater accuracy for long term predictions of inclination, beta angle, and mean local time
- Lifetime predictions for Aura shows that the spacecraft will have sufficient fuel to maintain its current orbit within the Afternoon Constellation through December 2023
- Aura will hold sufficient fuel in reserve after exiting the constellation to lower perigee such that reentry will meet the NASA 25-year reentry requirement.
- Analyses are updated annually by ESMO Flight Dynamics Team
 - Currently developing a retrograde maneuver capability



Debris Assessment Software

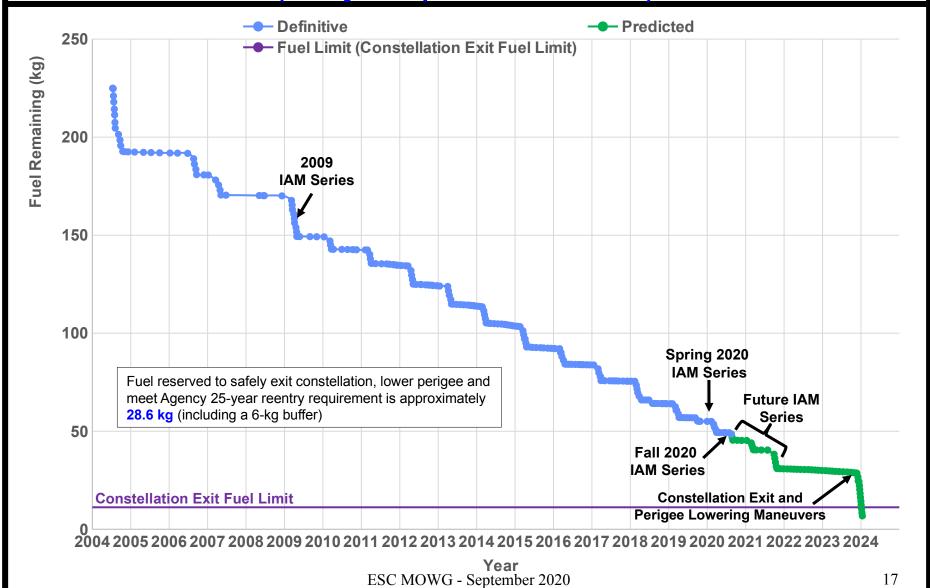


- The Debris Assessment Software (DAS) was created by the Orbital Debris
 Office at Johnson Space Center and is the Agency standard for end of
 mission life analyses and lifetime estimations (Version 3.0)
- Solar Flux file from April 2020 (New analysis to be run with <u>July 2020</u> file)
- DAS requires several inputs describing the spacecraft's mission:
 - Start apogee = ~696 km (varies slightly each year by constellation exit results)
 - Spacecraft Dry Mass = 2791.746 kg (includes 1.2 kg of unusable fuel and 4.8 kg of uncertainty)
 - Arr Tumbling Area = 46.1 m² (FDSS-II-07-0085_Aura Average Area _V1.0 (3/1/17))
 - Area-to-Mass Ratio = Tumbling Area / Dry mass = 0.016485 m²/kg
- In turn, DAS outputs:
 - If the mission is compliant with NASA requirements for limiting orbital debris
 - A recommended apogee and perigee that will allow the spacecraft to reenter within a specific period and satisfy the NASA requirements
- Aura has a waiver to the 30-years from launch requirement
- Aura will hold sufficient fuel in reserve to meet the 25-year requirement



Fuel Usage: Actual & Predicted

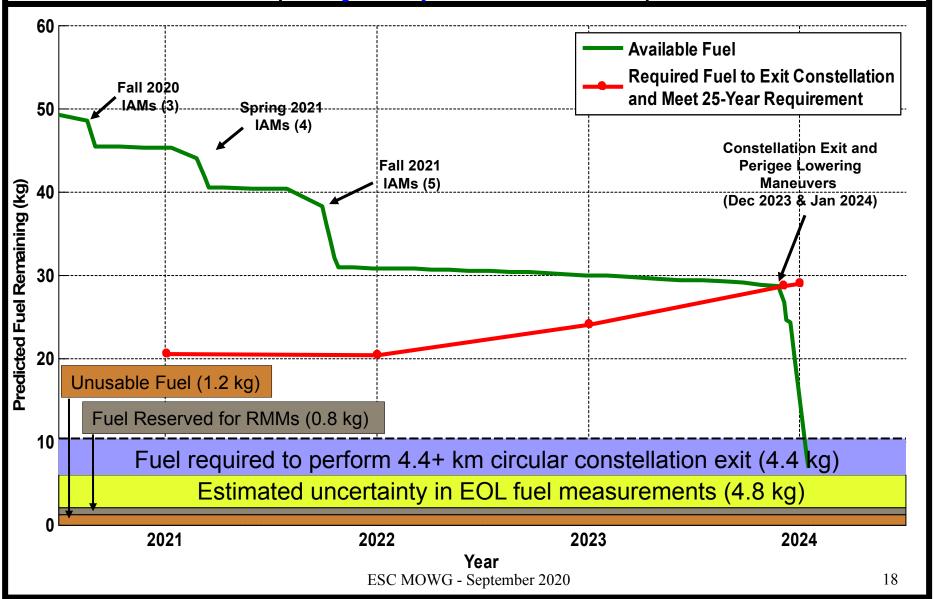






Aura DAS End of Life Predictions





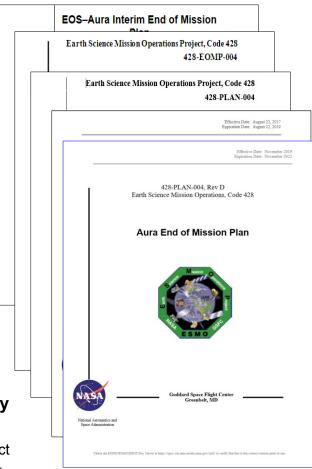


Aura End of Mission Plan (EOMP)



(No Change - Rev. D Updated Fall 2019)

- Initial draft February 2009
- Produced the first "Interim" End of Mission Plan (EOMP) in May 2011
 - Approved by NASA HQ July 2011
- Produced EOMP Rev A: February 2013
 - Updated Lifetime estimates, Small Object Collision Assessment
 - Waivers were approved in May 2013
- Produced EOMP Rev B: February 2015
 - Updated Lifetime Estimate
- Produced EOMP Rev C: August 2017
 - Lifetime estimates (as of 12/2016) & Reliability estimates
- Produced EOMP Rev D: November 2019 (Under Review)
 - Lifetime and Reliability estimates as of October 2019
- Content Synopsis:
 - Safely exit the A-Train Constellation
 - Passivate Aura to the extent possible for uncontrolled reentry
 - Aura has five (5) approved waivers for passivation
 - » Pressurant Passivation, Large Object Collision Probability, Small Object Collision Probability, Orbital Lifetime (30-Year), and Re-entry Risk (Uncontrolled)
- Final will be produced 60 days before End of Mission





Summary



- Spacecraft Status GREEN
- Instrument Status GREEN
 - HIRDLS: Chopper Stalled 03/17/08 Not collecting science data
 - MLS: Operating Normally
 - » 06/04/2018: 118 GHz Receiver-1A (R1A) Anomaly (Recovered 06/11/18)
 - » 06/20/2018: GHz Mirror Electronics (GME-B) Anomaly (Recovered 06/26/18)
 - » 07/10/2018: MLS Survival Mode Transition (Recovered 07/18/18)
 - » 10/25/2018: GHz Mirror Electronics (GME-B) Anomaly (Recovered 10/25/18)
 - » 01/27/2019: MLS Survival Mode Transition (Recovered 01/31/19)
 - » 07/18/2019: 190 GHz Receiver-2 (R2) Anomaly (Recovered 07/24/19)
 - OMI: Operating Normally
 - » 07/30/2018: OMI IAM Warm Restart (Recovered 07/31/18)
 - TES: Instrument Decommissioned on 01/31/18
- Data Capture/L0 Processing Status GREEN
 - SSR Data Capture to 07/31/20: 99.99530657%
- Ground Systems GREEN
 - Responding to new security requirements and upgrades to obsolete hardware or COTS systems, as required
 - 01/16/2020: Online (Eclipse) Build 22.00 ORR
 - 09/03/2019: EOS Automation (EA) Release 3.3 ORR





Questions?





Additional Charts

Maneuvers & Ground Track History
Orbital Trends

Aura Conjunction Assessment High Interest Events (HIEs)

Data Capture & Operations Errors

Extended Mission Plans(Analysis Updates)



Orbit Maintenance



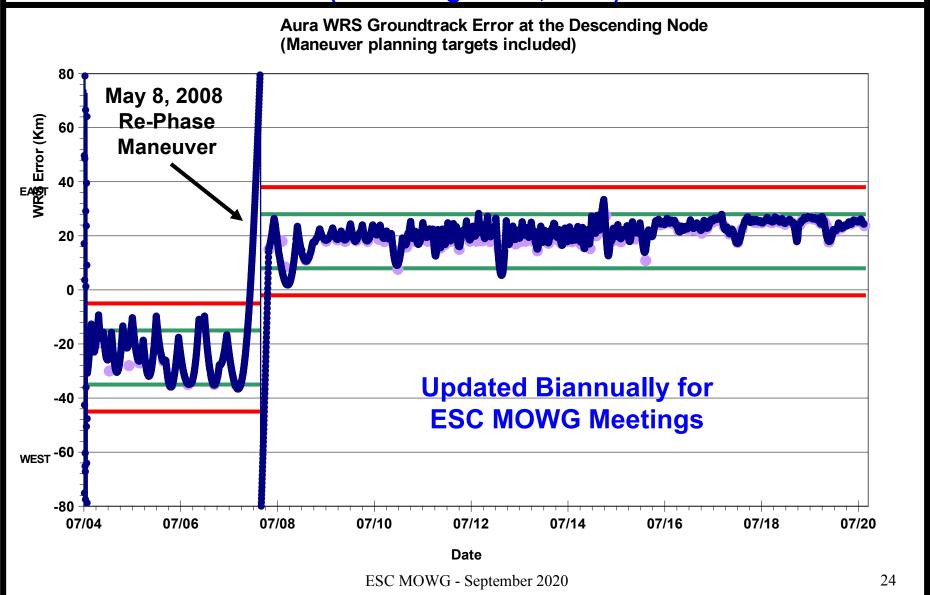
- Mission Requirements: Perform Drag Make-Up Maneuvers (DMUMs) to maintain Ground Track Error (GTE) with respect to the World Reference System (WRS-2)
 - Requirement: +/-20 km as measured at the Descending Node
- To meet coincident viewing requirements, Aura's initial ground track was offset from Aqua's by one WRS path plus 25.4 km
 - Aura was maintained -5.4 to -45.4 km west of Aqua until late 2007
 - Since May 8, 2008, a new control box, +/- 10 km from a +18 km (east) offset of the Aqua
 WRS-2 path is used to maintain MLS-CALIPSO viewing request
- Control Box Excursions: To date there have been 3 Control box Excursions
 - 2 on +10km front-side: 9/5/12 to 9/6/12, and 03/23/2015 to 04/17/2015 (increase in drag)
 - 1 on -10km back-side: 2/12/13 to 3/13/13 (drop in drag after DMUM on 1/16/13)
- To date a total of 136 Drag Make-up (DMU) maneuvers have been performed:
 - 07/19/2012: DMUM # 43 No Yaw Slew Maneuver (NYS) #1
 - Last maneuver 07/29/2020 (DMU #136) Next DMU will be in mid-October
 - Variation in performance from -6.7% (cold) to +5.3% (hot)
- To date a total of 70 Inclination Adjustment Maneuvers (IAMs) have been performed:
 - Fall '04 (4), Fall '06 (4 of 6), Spring '07 (4), Spring '09 (9), Spring '10 (3), Spring '11 (3), Spring '12 (4), Spring '13 (4), Spring '14 (4), Spring '15 (5), Spring '16 (4), Spring '17 (4), Spring '18 (5), Summer '18 (1), Spring '19 (4), Fall '19 (1), Spring '20 (4), & Fall '20 (3)
 - Variation in performance from -7.2% (cold) to +3.5% (hot)



WRS Ground Track Error (GTE)



(As of August 22, 2020)

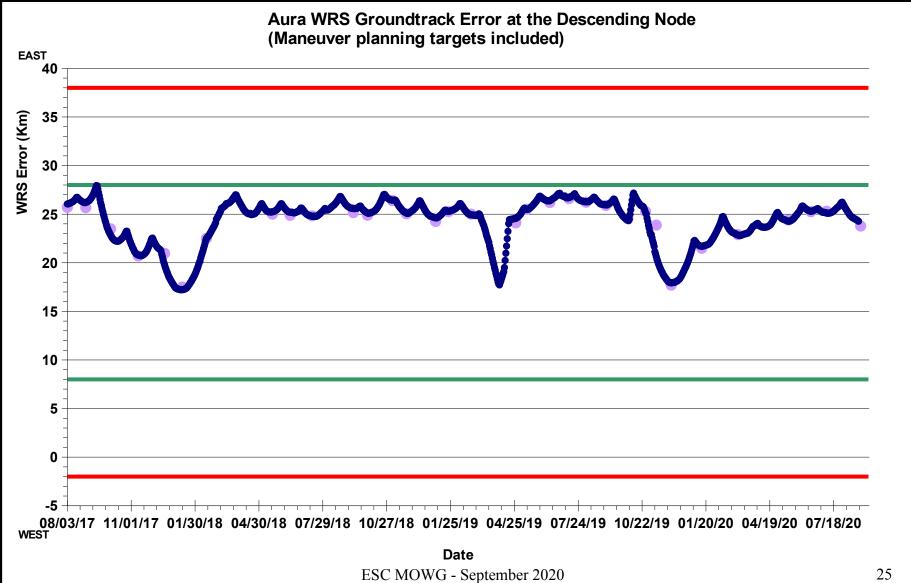




WRS Ground Track Error (GTE)



(As of August 22, 2020)

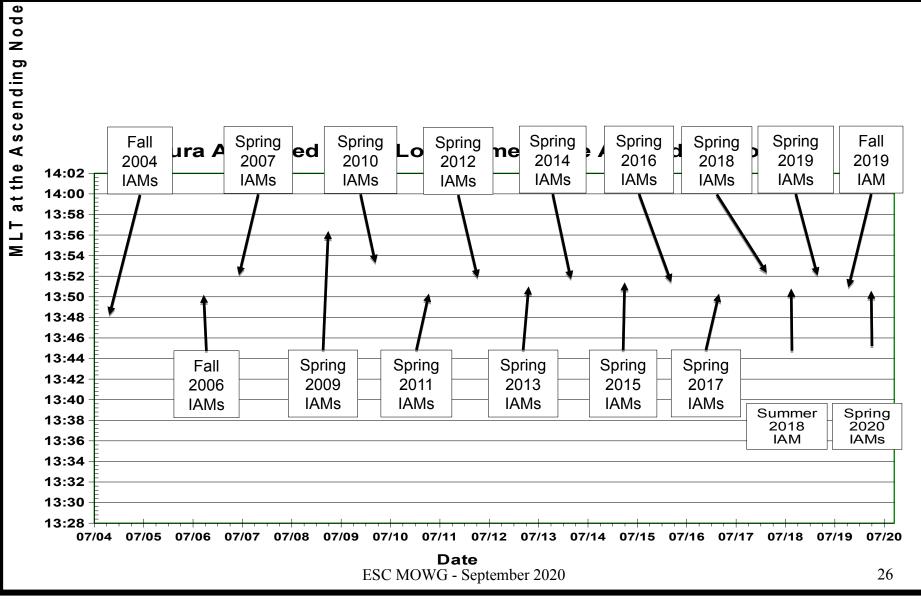




Aura Averaged MLT @ Ascending Node

NASA

(As of August 22, 2020)

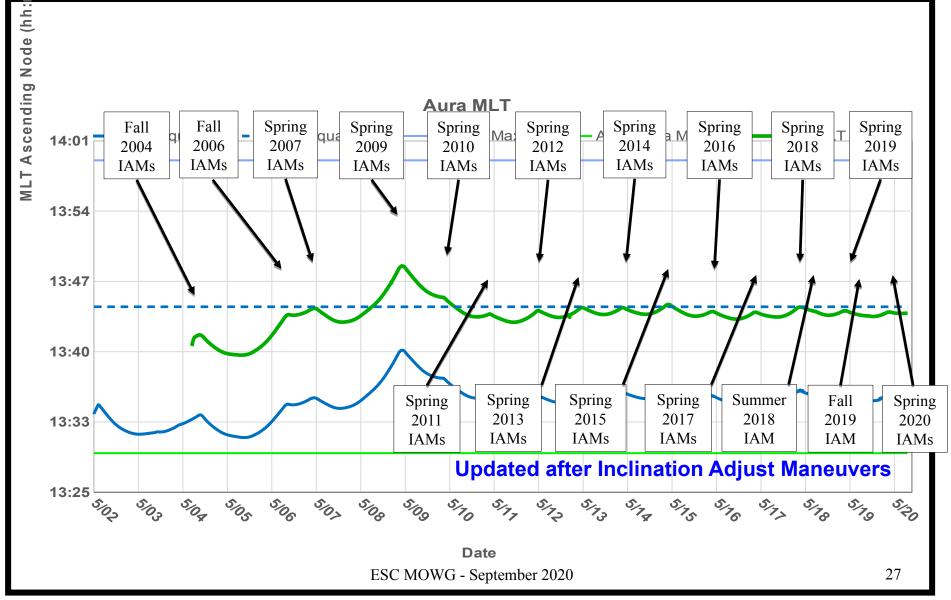




Aqua/Aura Mean Local Time (MLT)



@ Ascending Node (As of August 22, 2020)

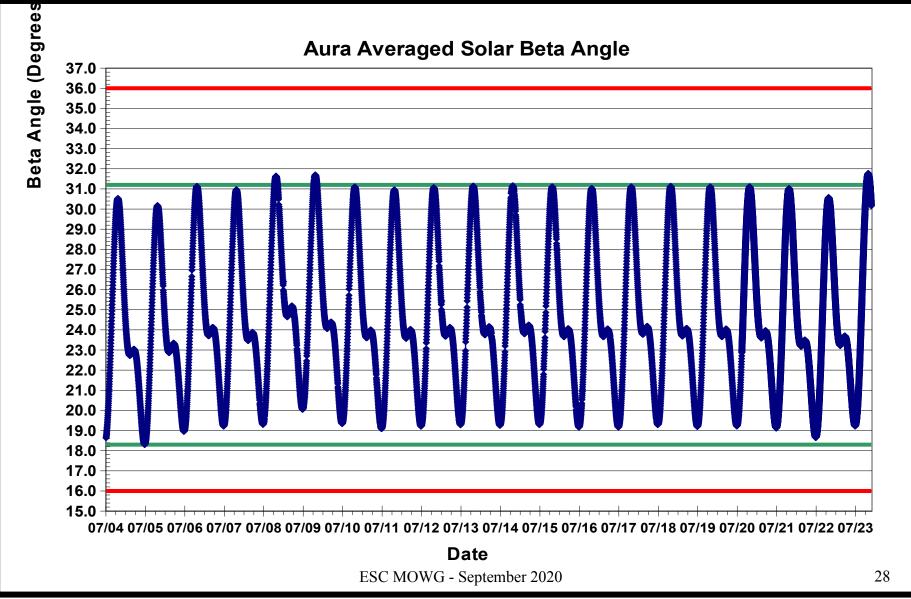




Aura Predicted Beta Angle



(With Yearly Inclination Maneuvers) (Updated June 2020)





Aura and Landsat-8 (LS-8) Orbit Phasing



With Aura in the intersection point LS-8 will be ~ 77 seconds away from the intersection Point worse case

Landsat 8 GCOM-W Aura AN DN Terra

By Design – LS-8 and LS-7 are ½ orbit apart

In 2020 there has been 276-342 seconds between Aura and LS-8

> 1 Orbit = ~ 100 minutes ESC MOWG - September 2020

Terra ~ 30 min behind LS-7

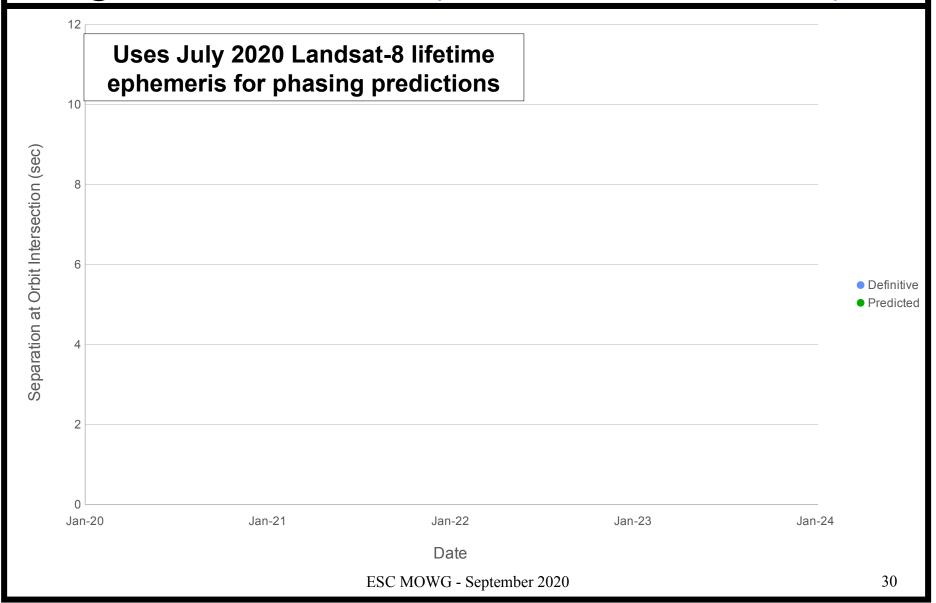
29



LS-8/Aura Phasing at Poles



@ Northern Intersection Point (Current Baseline Plan - June 2020)





Aura Conjunction Assessment



Tier 1 – Notify (email/phone), Tier 2 – Conduct Briefing,

Tier 3 – Plan Maneuver, Tier 4 – Execute Maneuver

High Interest Events (HIEs)

	Dec `19	Jan `20	Feb `20	Mar `20	Apr `20	May `20	Jun '20	Jul '20	Aug '20	Total
Tier 1	0	0	0	0	0	0	0	0	0	0
Tier 2	0	0	0	0	3	0	0	0	0	3
Tier 3	1	0	1	0	1	0	0	0	1	4
Tier 4	0	1	0	0	0	0	0	0	0	1
Total	1	1	1	0	4	0	0	0	1	8

2016: 24 CARA HIEs – 16 required significant action (T2-T4)

2017: 19 CARA HIEs - 16 required significant action (T2-T4)

2018: 16 CARA HIEs - 16 required significant action (T2-T4)

2019: 15 CARA HIEs – 15 required significant action (T2-T4)

15. 12/23/2019: CA vs. 44532 at 14:10:27 GMT – DAMs planned and screened, Self-mitigated (T3)

2020: 7 CARA HIEs – 7 required significant action (T2-T4)

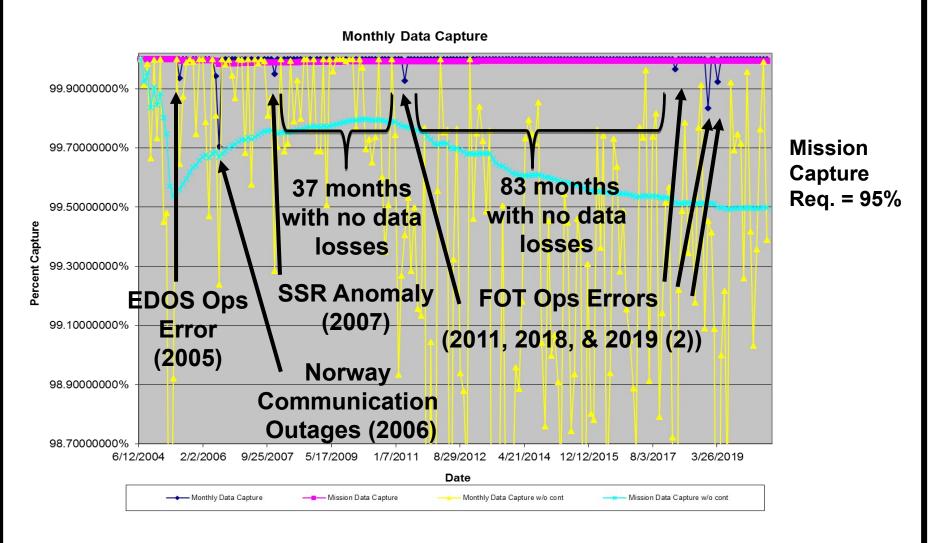
- 16. 01/03/2020: CA vs. 13498 at 22:50:31 GMT DAMs planned and screened, rescheduled DMU earlier (T4)
- 17. 02/08/2020: CA vs. 31249 at 02:08:20 GMT DAMs planned and maneuvers screened (T3)
- 18. 04/16/2020: CA vs. 35464 at 05:47:24 GMT DAMs planned and maneuver screened (T3)
- 19. 04/25/2020: CA vs. 45131 at 22:07:12 GMT Contacted ONEWEB team via CARA, they replanned ascent (T2)
- 20. 04/26/2020: CA vs. 45131 at 04:42:42 GMT Contacted ONEWEB team via CARA, they replanned ascent (T2)
- 21. 04/26/2020: CA vs. 45131 at 06:21:36 GMT Contacted ONEWEB team via CARA, they replanned ascent (T2)
- 22. 08/30/2020: CA vs. 44019 at 18:42:21 GMT DAMs planned and maneuver screened (T3)



Aura Monthly Data Capture



SSR Data Capture to 07/31/2020: 99.99530657%



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SSR Data Losses – 2020



Last Data Loss: April 2019 (FOT Ops Error)

April 2019: Data Loss #1029 on DOY 094 (April 04, 2019)

Data gaps were observed in Low Rate Data from 14:11:54 -

14:46:02 and in OMI data from 14:12:26 - 15:10:47

January: None

February: None

March: None

April: None

May: None

June: None

July: None

August: None

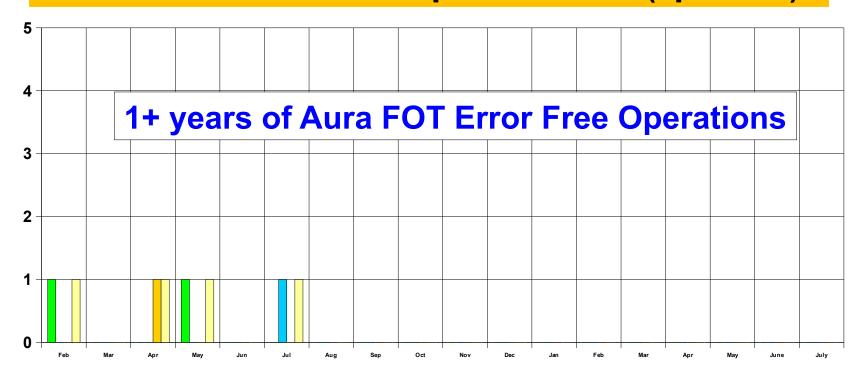


Operational Errors



(18-Months: February 2019 - July 2020)

Aura: 15 Months since last operational error (April 2019)



ESC MOWG - September 2020



Aura Baseline Decommissioning Plan



(Current Baseline Plan – Analysis Updated June 2020)

Baseline Decommissioning Plan Assumptions:

- Maintain MLT and WRS-2 Ground Track requirements until the DAS 25-year re-entry fuel limit is reached
 - Perform nominal IAMs to maintain MLT
 - Perform periodic DMUs to maintain Ground Track Error

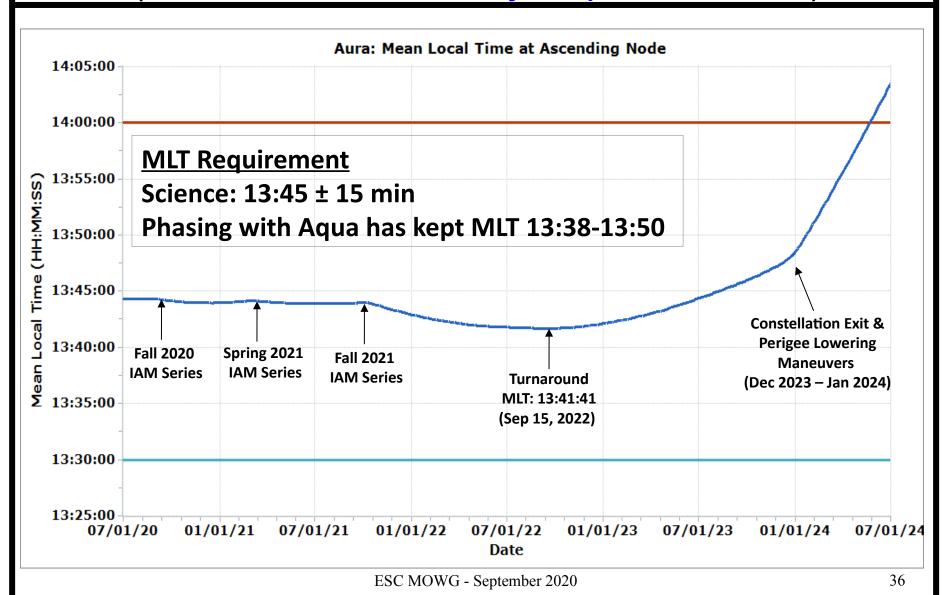
Documented in 'FDSS-III-110-0024_Aura_Lifetime_Analysis_Spring2020_v4.0.pptx' (06/25/20)



Aura Predicted Mean Local Time



(Current Baseline Plan – Analysis Updated June 2020)

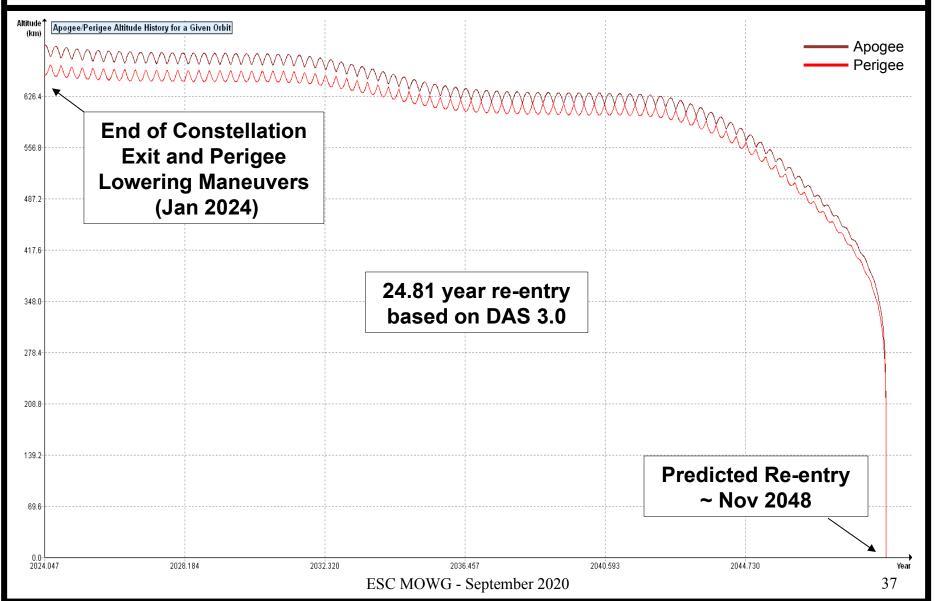




Aura Predicted Re-entry



(Current Baseline Plan - Updated June 2020 - April 2020 DAS Solar Flux File)

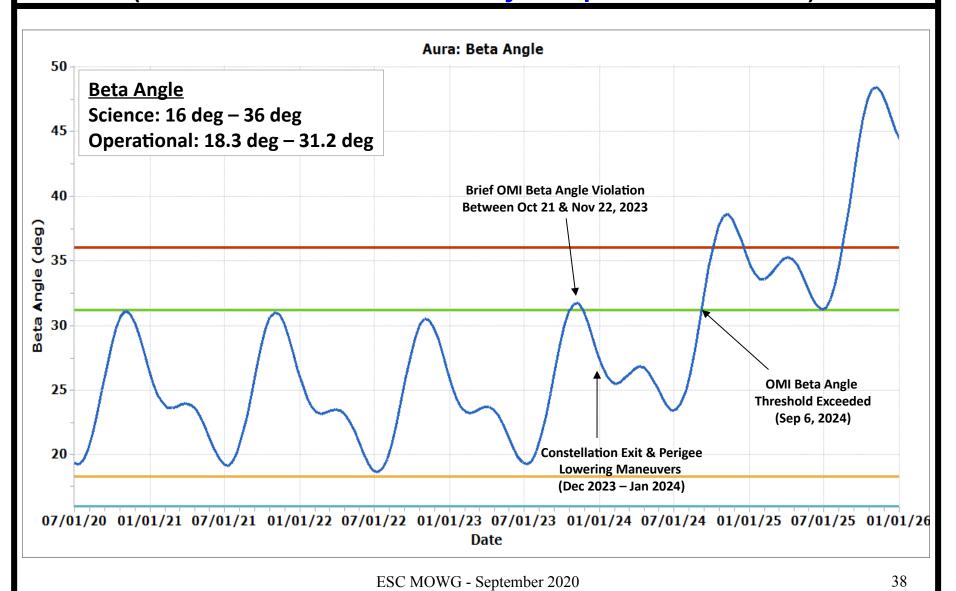




Aura Predicted Beta Angle



(Current Baseline Plan - Analysis Updated June 2020)

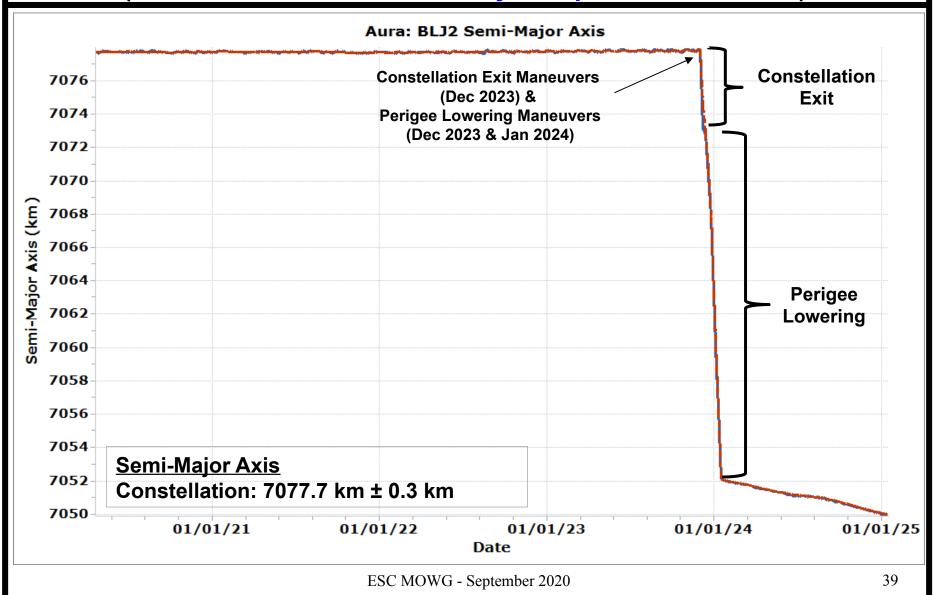




Aura Predicted Semi-Major Axis



(Current Baseline Plan - Analysis Updated June 2020)

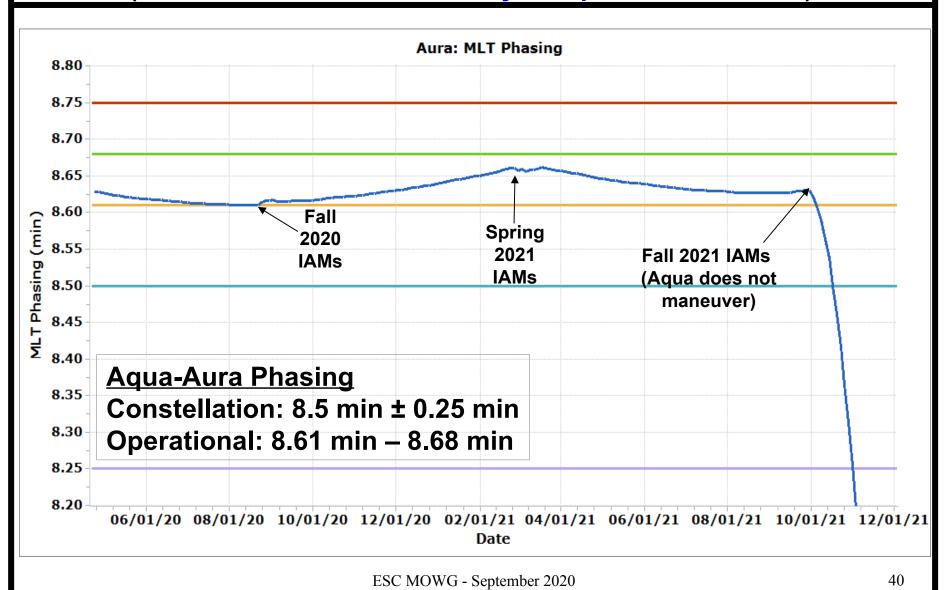




Aura MLT Phasing with Aqua



(Current Baseline Plan - Analysis Updated June 2020)





Abbreviations / Acronyms List



ARE – CA –	Array Regulator Electronics Conjunction Assessment	FMU – FOT –	Formatter Multiplexer Unit Flight Operations Team	MLT – MMOD –	Mean Local Time Micrometeorite Orbital Debris
CALIPSO -	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations	FSW – FY –	Flight Software Fiscal Year	MOCA -	Mission Operations Conjunction Assessment
CARA – CDH –	Conjunction Assessment Risk Analysis Command & Data Handling	GHz – GME – GMT – GNC –	Gigahertz Gigahertz Mirror Electronics Greenwich Mean Time	MOWG - MWG - NASA -	Mission Operations Working Group Maneuver Working Group National Aeronautics & Space
CEM – COMM –	Constellation Exit Maneuver Communications	GSFC -	Guidance Navigation & Control Goddard Space Flight Center	NGSS -	Administration Northrop Grumman Space
CONOPS - COTS - CRMS -	Concept of Operations Commercial-Off-The-Shelf Collision Risk Management	GTE – HIE – HIRDLS –	Ground Track Error High Interest Event High Resolution Dynamics	NYS – Ops –	Systems No Yaw Slew Operations
DAM - DAS -	System Debris Avoidance Maneuver Debris Assessment Software	HK –	Limb Sounder Housekeeping	OMI – ORR – PLM –	Ozone Monitoring Instrument Operational Readiness Review Perigee Lowering Maneuver
DMUM – DR –	Drag Make-up Maneuver Decommissioning Review	HQ – IAM – IAM –	Headquarters Interface Adapter Module Inclination Adjustment	PROP – R1A –	Propulsion Receiver 1A
DRR – DWG –	Disposal Readiness Review Decommissioning Working Group	INC –	Maneuver Inclination	R2 – RM – RMM –	Receiver 2 Retrograde Maneuver
EA – EDOS – EOC –	EOS Automation EOS Data Operations System EOS Operations Center	INST – IOT – KDP-F –	Instruments Instrument Operations Team Key Decision Point to proceed with Phase F	RWA – SR – SRP –	Risk Mitigation Maneuver Reaction Wheel Assembly Senior Review Senior Review Proposal
EOL - EOMP - EOS -	End of Life End of Mission Plan Earth Observing System	kg – km –	kilogram kilometer	SSR – TCS –	Solid State Recorder Thermal Control System
EPS – ESA –	Electrical Power System Earth Sensor Assembly	KNMI – L0 –	Royal Netherlands Meteorological Institute Level-Zero	TES – TSF –	Tropospheric Emissions Spectrometer Thrust Scale Factor
ESC - ESMO -	Earth Science Constellation Earth Science Mission Operations	LS - m - MLS -	Landsat meters Microwave Limb Sounder	WRS –	World Reference System
FDS –	Flight Dynamics System				